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ABSTRACT

This study examined infants' change in visual information pick-up, from an infant-like stimulus-locked visual scanning pattern to an adult-like cognitive control of visual information pick-up. Subjects were 21 children between 25 and 42 months of age. Eye movements were videotaped in a preferential looking situation and later analyzed as still pictures. Results revealed a change in the visual looking pattern occurring during a brief period between 32 and 33 months of age. In younger children, presentation of a peripheral stimulus elicited a corresponding saccadic eye movement followed by a 2- to 3-second period of stimulus-locked attention. In older children, the initial stimulus fixation lasted less than 0.1 seconds and was followed by an eye movement in the opposite direction, initiating a search of the visual scene. This difference indicates a developmental change in the cognitive control of information pick-up. (MM)

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ED 363 399

CHILD LOOKING PATTERNS: A SUDDEN CHANGE IN VISUAL INFORMATION PICK-UP AT 32 MONTH OF AGE

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Abstract

Recording the eye movements of young children in a preferential looking situation reveals a change in the visual looking pattern occuring during a very brief time between 32 and 33 month of age. In the younger children, presentation of a peripheral stimulus elicited a corresponding saccadic eye movement followed by a 2-3 sec. period of stimulus-locked attention; in the older children the initial stimulus fixation lasted less than 0.1 sec. and was followed by an eye movement in the opposite direction, initiating a search of the visual scene. This change indicates a developmental change in the cognitive control of information pick-up.

Introduction

Visual organisms collect information by moving the eyes across the visual scene. Human infants inspect a visual stimulus by a series of short saccades and brief fixations of stimulus contours (Salapatek & Kessen, 1973), in the first weeks of age concentrating on a single prominent feature of the stimulus (Bronson, 1990). The duration of individual fixations during stimulus inspection are shorter in infants than in adults (Harris et al., 1988). It is also evidence that the intial search phase of the visual scanning pattern is different in adults and infants. Adults search the visual field before an attentional stimulus is chosen (Stark & Ellis, 1981), infants, on the other hand, react spontanously to non-foveal stimulation by a corresponding saccadic eye movement towards the target, followed by a comparatively long attentional period when fixation is locked on the stimulus (Fantz, 1958). If two stimuli are presented infants tend to attend the stimulus with highest visibility (Banks & Ginsburg, 1985), whereas the adult choice is controlled by stimulus

content and meaning. We have recorded the eye movements of young children in a preferential looking situation, and present evidence that the change from an infant-like, stimulus-locked visual scanning pattern to an adult-like cognitive control of visual information pick-up occurs during a very brief time around 32 months of age.

Methods

Subjects were 21 children (10 males, 11 females) between 25 and 42 months, recruited from a nearby kindgarden. All children met the following criteria: (a) Normal acuity tested with "Teller Acuity Cards", (b) normal course of development following a term birth. The stimuli were neutral square-wave luminance gratings photographed on slides and back-projected on a plexiglass screen. The gratings, subtending 12,5 x 12,5 deg. visual angle, were randomly presented to the left or the right, at a distance of 14 deg visual angle from the center of the stimulus field. Each subject was presented with 15 gratings varying in spatial frequency (periodicity) from .32 to 38.0 c/deg in half octave steps, in a standard staircase procedure. Stimulus exposure was 10 seconds. To maintain the child's attention between trials black-and-white cartoon-figures were presented between each stimulus exposure. The child was seated in a chair by him/her self or on the lap of an adult from the kindergarden staff, facing the screen at a distance of 55 cm. Each trial started by presenting a cartoon centered on the screen, and as the child watched the cartoon, it was replaced by a left or right grating.

Eye movements were vidèotaped and later analysed as still pictures. The vidèo records had a temporal resolution of 24 stills per second. To mark eye positions a frame with two movable vertical strings were attached to the monitor.

Saccade length and direction of saccdes in the initial search phase of the visual scanning, and the attentional time to the stimulus were scored. The agreement between two transcribers in scoring was 97%. Included all trials with interrater agreement.

Results

Two distinct eye movement patterns were observed in the initial search phase, whose occurence were mutually exclusive in the individual subject. The typical (type 1) response observed in the youngest children upon pheripheral presentation of the grating is a long saccade towards stimulus, followed by a long visual attention time (mean duration 2.57 sec; sd 0.8) to that stimulus. A second (type 2) pattern, observed in the older children is a short eye movement towards stimulus, followed by a brief fixation (duration < 100 msec.), in turn followed by a second eye movement in the opposite direction, initiating a more detailed scanning in the complete visual scene. The precise later-age visual scanning pattern is not readily observed by direct inspection; eye movements recording is necessary to detect the first short saccade and fixation. Indeed, in clincal work a type 2 scanning pattern is easily interpreted as an avoidance response. Figure 1, plotting the distribution of the two scanning patterns among the subjects, shows that the change occurs suddenly at 32 months of age.

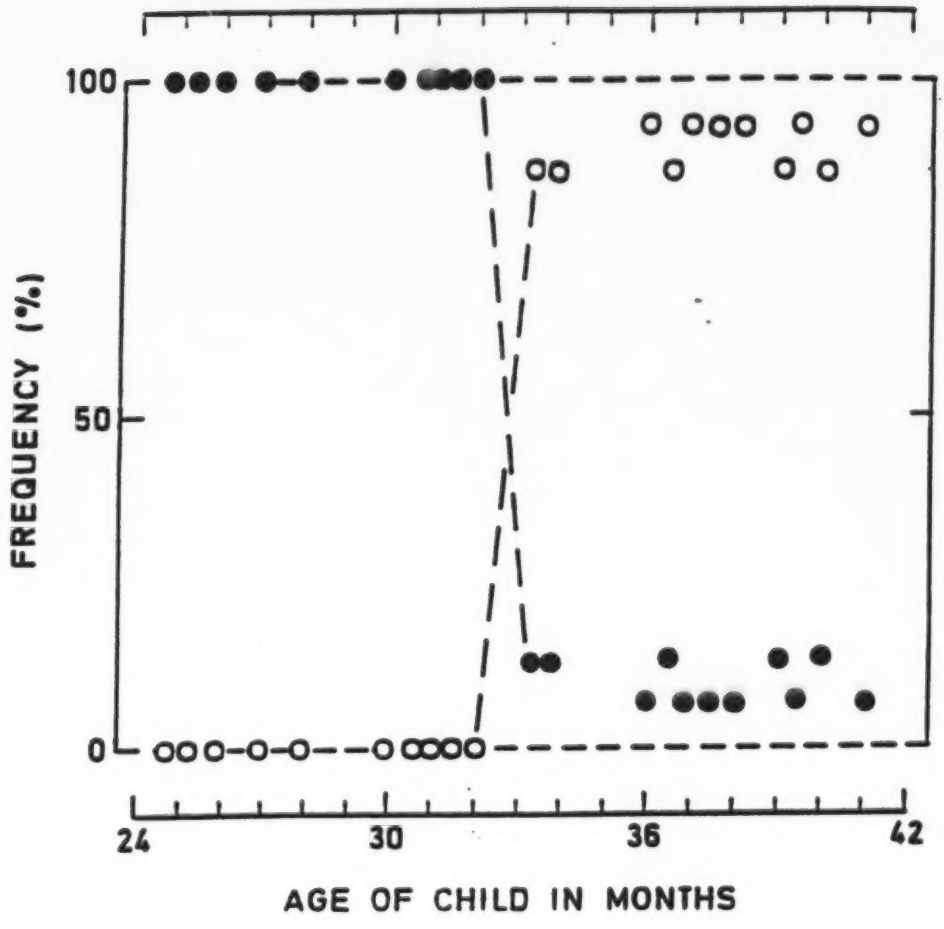

Figure 1. Number of preferential-looking trials (n=15) that elicited type 1 and type 2 scanning patterns in 21 children, between 25 and 41 months of age. Each child is represented by two points vertically lined.

Discussion

Stimulus control of the information pick-up prosess may be adaptive for cognitive development in the very young child (Banks, 1980; Turkewitz & Kenny, 1985), assisting the formation of visual representations by directing attention to novel stimuli. Lifting these early restrictions allows the child to scan more freely and choose a visual target, which in turn may facilitate later cognitive development by allowing the child to choose among a broader sample of stimuli to attend to. It is interesting to note that the timing of this change in the information pick-up process, around 2.5 yr, accompanies other major changes in early development: It is the time when tests of cognitive abilities become predictive of later behaviour (Honzik, 1983; McCall, Hogarty & Hurlburt 1972), and it is the time when childhood amnesia ends (Freud, 1953; Nelson & Ross, 1980; Nadel & Zola-Morgan; 1984). The change in eye movement pattern may thus be a local sign of a global change in cognitive processing. We have preliminary observations on severely mentally retarded children and adult patients which show consistent infant-like scanning patterns in these subjects, strongly suggesting that the change is related to cognitive development rather than chronological age.

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